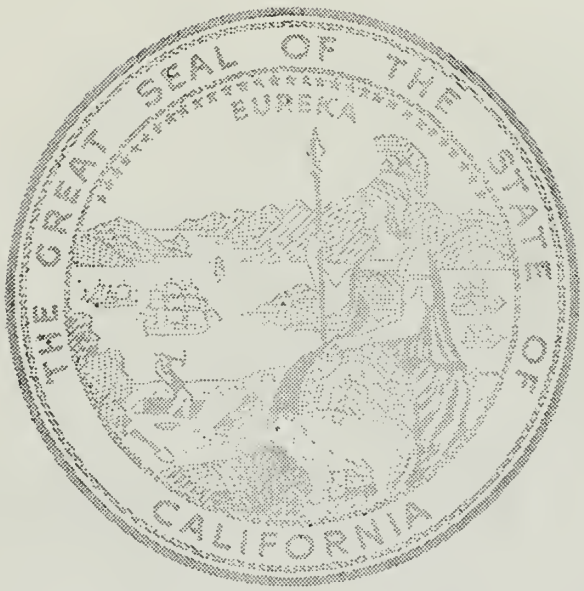
SPECIAL PUBLICATION 52
First Edition

EARTHQUAKE CATALOG OF CALIFORNIA JANUARY 1, 1900-DECEMBER 31, 1974

1978

Prepared by
THE CALIFORNIA DIVISION OF MINES AND GEOLOGY



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SPECIAL PUBLICATION 52

EARTHQUAKE CATALOG OF CALIFORNIA JANUARY 1, 1900–DECEMBER 31, 1974

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By

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1978

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(Pocket, Inside Back Caver)

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By Charles R. Real,
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and David L. Parke

INTRODUCTION

Although the State of California lies in one of the most seismically active areas of the world, the abundance of natural resources and mild climate has encouraged settlement and accelerative population growth since the mid-1800s. As a consequence, destructive earthquakes over the years have claimed more than one thousand lives and have caused property losses in excess of one billion dollars. The earthquake risk in California has increased in direct proportion to population and urbanization, and will continue to do so as cultural growth expands into seismically hazardous areas of the state.

Mitigating earthquake hazard demands effective land use planning which in turn requires knowledge of the statewide distribution and character of seismically active areas. Presently, the most effective means of assessing the seismic hazard is based on historical records of earthquake-related data including epicenter location, intensity of shaking, severity of damage, and the location and frequency of ground rupture for each event. In practice, however, this approach is severely hampered by the scattered distribution of these data. A strong need exists to condense and centralize historical earthquake data.

Recognizing this need, the California Division of Mines and Geology (CDMG) established the Earthquake Catalog Program in 1973, aimed at researching and compiling the earthquake history of California into a unified data file. Pertinent information is being collected for earthquakes having epicenters or effects in California from the earliest reports in 1769 to the present. The intention of the program is to provide a comprehensive source of historical earthquake data useful for evaluating regional and local earthquake hazard, and to dispense this information widely in the most useful forms. An efficient database management system utilizing high-speed, large-scale digital computers was required for the rapid storage and retrieval of earthquake data.

Twenty four parameters have been identified as providing the most fundamental and useful information regarding each particular earthquake occurrence. These parameters relate to location in time and space, size estimates, damage estimates, and the primary sources of this information about each event. For the earthquakes that have occurred since 1932, when statewide seismographic coverage was established, these data have been continuously measured and tabulated by governmental and academic institutions and, for the most part, already reside on digital magnetic tape files. Post-1932 data files, therefore, needed only editing and merging to provide the maximum available uniformity of coverage throughout the state.

For the period before 1932, much more effort was required to obtain useful information, primarily because uniformity in reporting pre-1932 earthquakes depended largely on population distribution and because the accuracy and methodology of seismographic instrumentation were not available until later. The importance of an extensive historical record cannot be overstated. Meaningful projections of future earthquake activity must rely on patterns or trends contained in the historical record. Confidence in interpretive conclusions drawn will increase only with the span of the historical record.

The Earthquake Catalog Program is being carried out in three phases (figure 1); the first two phases have been completed. During phase one, accounts were compiled of the larger pre-instrumental earthquakes and all of the instrumentally recorded events. At this stage, principal sources of information were identified, an inventory of references was compiled, and some preliminary historical research was conducted. A prototype database management system was developed and implemented. During phase two, data from felt reports were analyzed to improve epicenter locations and to assign magnitudes to pre-instrumental earthquakes that occurred from 1900 to 1932. Intensity data were collected and interpreted, and locations and magnitude assignments were revised. Phase two also included the merging of the post-1931 earthquake data. Phase three, the research and compilation of the pre-1900 earthquake data, began in early 1978 and will continue for at least two years.

Owing to the continuously evolving nature of the catalog data file, and the increasing demand for a comprehensive catalog of earthquakes for research and seismic hazard assessment, the Division is releasing this information as a series of catalog editions. Each new edition extends the period of coverage further back as well as forward in time, as new or additional information becomes available. Editions of the catalog will be released on a more or less annual basis and will be available in two forms: a magnetic tape file and a microfiche file. The entire catalog will not be published in paper form because most of the data on earthquakes since 1932 is already

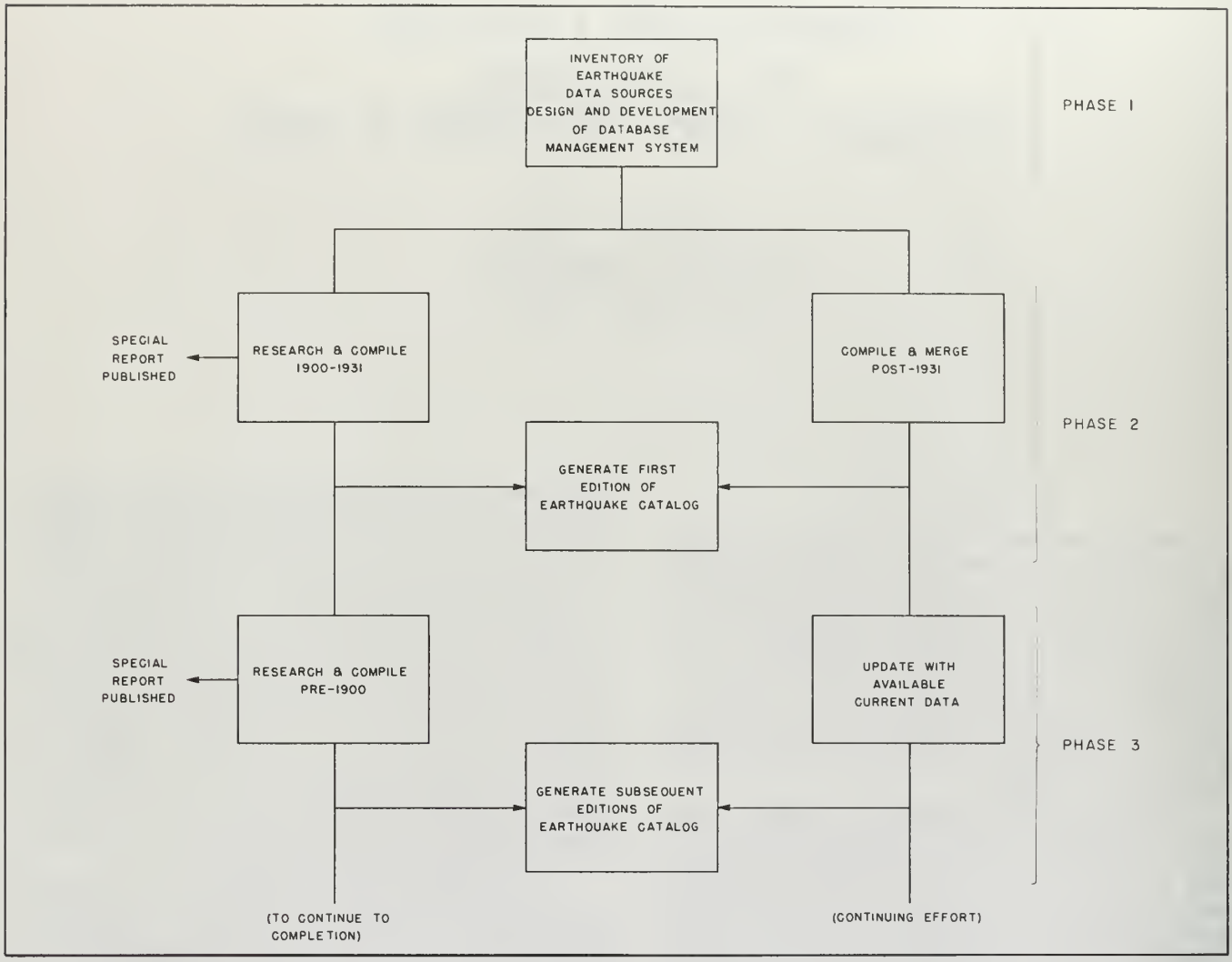

FIGURE 1. Earthquake Catalog Program Phases

available in that form from the primary sources. Furthermore, the catalog in printed form would exceed 2,000 pages and would be difficult to handle and costly to publish. From a practical standpoint, information from a catalog of this size is more easily stored and accessible on digital magnetic tape or microfiche. Because the CDMG is a primary data source for catalog information before 1932, however, these early data have been published in paper form (see California Division of Mines and Geology Special Report 135, "Seismicity of California 1900–1931").

This text accompanies the first edition of the CDMG earthquake catalog, "Earthquake Catalog of California," covering the period 1900–1974, and identifies record content, catalog formats, sources of information, method of catalog synthesis, and estimates of completeness. Although the catalog data file has undergone extensive review and editing, errors are inescapable in a product of this scope and nature. Reports of errors, omissions, or other discrepancies are openly solicited so that future editions of the Earthquake Catalog will be improved. For this purpose, an error notification form is included as Appendix C.

CATALOG FORMATS

Magnetic Tape

Since it is not practical to include all types of earthquake information in a single data file, only the principal parameters most readily used in seismicity studies have been included. These parameters relate to location in time and space, size estimates, and damage estimates. Table 1 shows the record content in detail. Each event has been assigned a unique identification number, the first two digits of which designate locality by region (figure 2). Events located exactly on latitudinal or longitudinal boundaries are assigned to the adjacent regions to the north and west respectively. A reference number documenting the primary source of information follows each parameter or group of parameters. Keys to the parameter codes (appendix A) and the literature reference numbers (appendix B) are provided.

The catalog file is written on a 2,400 foot, 1/2-inch, quality magnetic tape certified at 6,250 bpi. The tapes are written as either nine or seven track and are labeled as such on the reel. The tape code is BCD, the packing

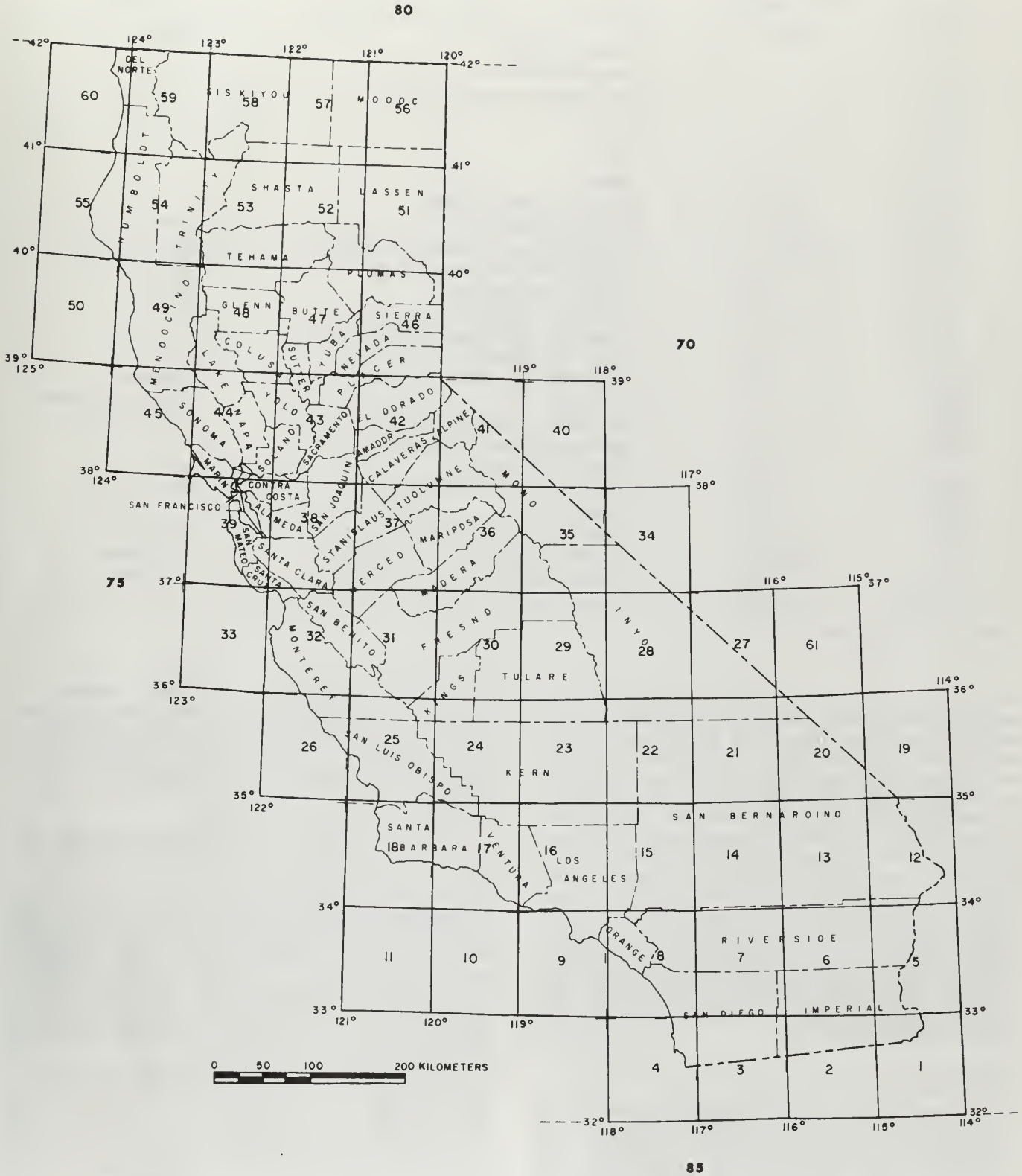

FIGURE 2. Index Map of California Showing Numbered Regions and Counties

TABLE 1. Magnetic Tape Logical Record Format

Field Position	FORTRAN* Read Format	Parameter	Description
1–2	I7	Region Number	———
3–7		Sequence Number	———
8–10	I3	Year (leading 1 suppressed)	———
11–12	I2	Month	———
13–14	I2	Day	———
15–16	I2	Hour	———
17–18	I2	Minute	———
19–21	F3.1	Second (to nearest tenth)	———
22–26	F5.3	North Latitude	Degrees
27–31	F5.3	West Longitude (leading 1 suppressed)	Degrees
32–34	F3.1	Focal Depth (to nearest tenth)	Kilometers
35–36	A2	Quality of Hypocenter	Code
37–39	A3	Hypocenter Literature Reference	Number
40–43	F4.2	Magnitude (999 means undetermined)	———
44	A1	Type of Magnitude	Code
45–47	A3	Magnitude Literature Reference	Number
48–51	I4	Felt Area	10^3 Sq. Kilometer
52–54	A3	Felt Area Literature Reference	Number
55–56	I2	Maximum Report Intensity	
57	A1	Type of Intensity	Code
58–60	A3	Intensity Literature Reference	Number
61–64	I4	Lives Lost	———
65–67	A3	Lives Lost Literature Reference	Number
68–73	F6.2	Property Damage	10^6 Dollars
74–76	A3	Property Damage Literature Reference	Number
77–120	11A4	Comments	———

*Decimal points are implied.

density is 800 bpi, and the parity is even. The tape is standard labeled and has a leading label followed by a tape mark, the earthquake data file, a second tape mark, a trailing label, and a third tape mark (figure 3). Logical record length of the data file is 120 bytes, and the records are blocked at 4,800 bytes. The first record of the data file is catalog identification information that contains the catalog edition, time period of coverage, and generation date in columns 77 through 120. Since the CDMG catalog file will be updated periodically, this information will serve as an important identifier. Logical records 2 through 39,579 correspond to the earthquake data file format shown in Table 1. The data file is chronological and is sorted by date and time to the hundredth place in seconds. A partial tape dump listing comes with each magnetic tape. This listing includes the tape serial number, the header label, the first and last five blocks of the data file, and the trailing label.

Microfiche

The earthquake catalog is presented in four files on microfiche: (1) a chronologic file of all earthquakes; (2) a chronologic file of earthquakes equal to or greater than magnitude 5.0; (3) a chronologic file of earthquakes equal to or greater than magnitude 6.0; and (4) a file of all earthquakes, sorted by region. Each fiche is numbered in the upper right hand corner and carries a descriptive heading across the top. The complete chronological file is on fiche 1 through 4; the magnitude 5.0 and greater file on fiche number 5; the magnitude 6.0 and greater file on fiche number 6; and the complete file by region on fiches 7 through 10.

Data is arranged on each fiche by pages. Each page contains about 50 earthquake records. The microfiche format is a 1:48 reduction, which allows for 288 frames (pages) on each fiche. The frames are addressed by numbering columns 1 through 18 across from left to right, and down rows A through P (figure 4). The first 18 frames across the top (A01–A18) are used for the fiche heading, and the last frame (P18) in the lower right hand corner is used for indexing. This leaves 269 frames (B01–P17) on each fiche for data—enough to contain about 13,000 earthquake records. A sequential file reads column by column, top to bottom, left to right.

Several aids have been used to simplify a file search. Each fiche has a visible heading across the top that contains the following information: (1) the key parameter (date or region number) of the first record on the fiche, (2) the catalog edition number and the time period of coverage, (3) the type of file, and (4) the fiche number. The fiche number or file type is used to identify the desired

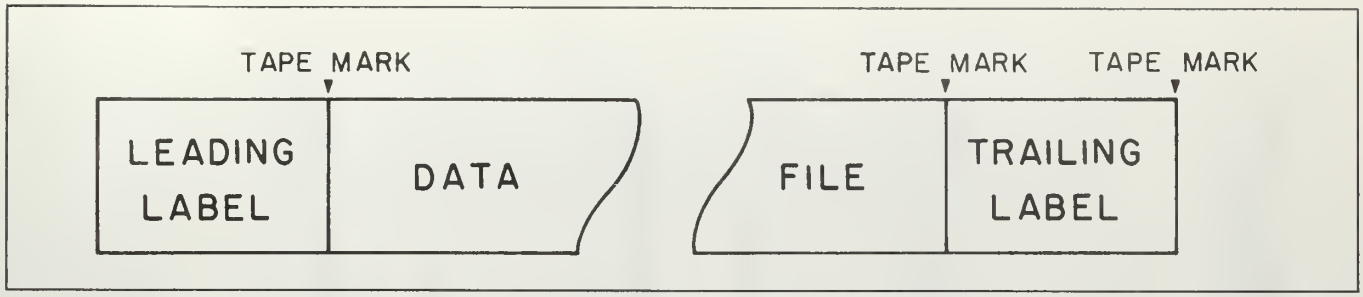

FIGURE 3. Magnetic Tape File Format

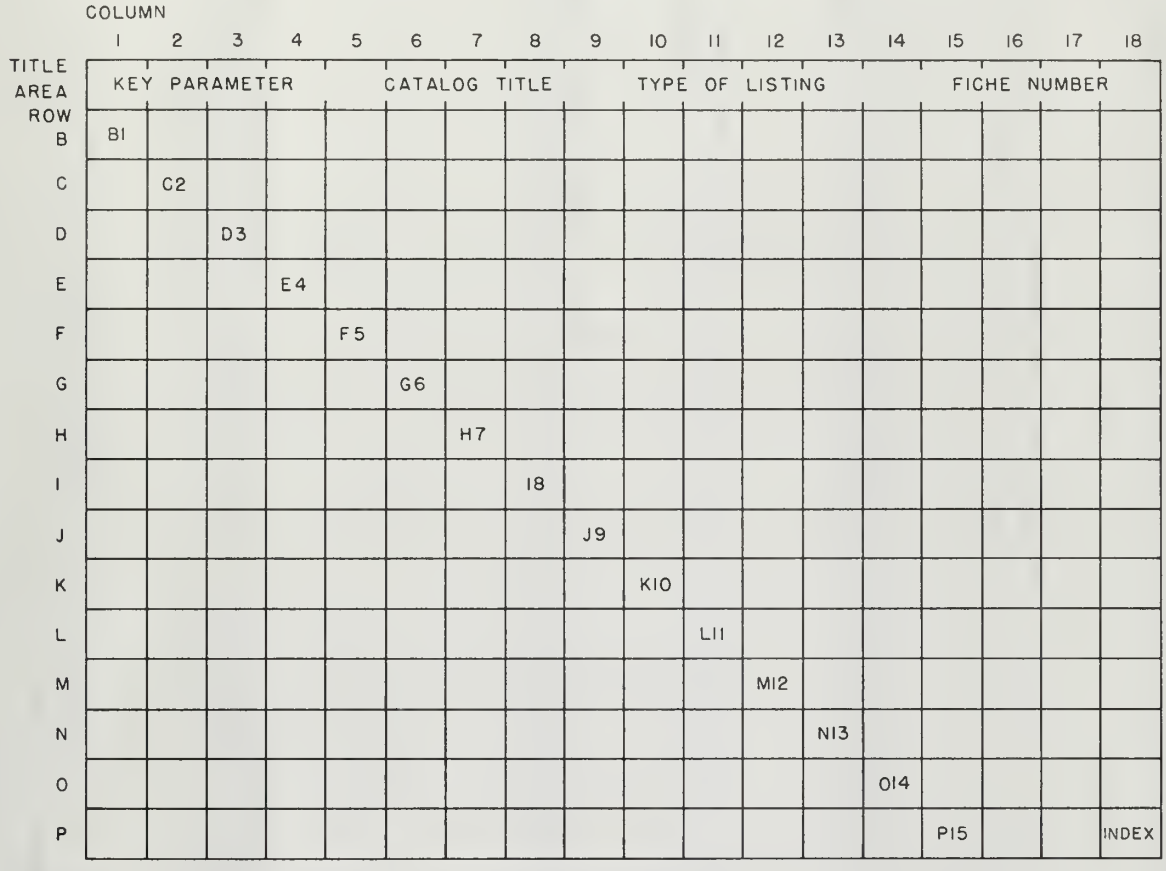

FIGURE 4. Microfiche Format

file. The key parameter is used to select the fiche containing the desired record, and the fiche index is used to identify the proper frame.

The index frame contains a table listing the key parameter and the corresponding frame address. This index is used in much the same manner that key words are used at the top of each page of a dictionary. For example, on the chronological file the fiche index contains date and frame address (figure 5). To find a particular record by date, the column is scanned until the nearest date on or before the date of interest is found. The corresponding address is then used to locate the frame containing the record of interest. The frame address appears in all four corners of each frame.

To locate earthquake records by time of occurrence, the chronological files are used. The magnitude 5.0 and greater and the magnitude 6.0 and greater files are included to simplify the chronological search for the larger earthquakes of engineering significance. All chronological files are sorted by date and time to the hundredths place in seconds.

The region file is used to identify earthquake records by epicenter location. Records are arranged in order of increasing region number. The region number (first two digits of the record identification number) corresponds to the one-degree quadrangle in which the epicenter lies as described previously (figure 2). Within a given region the earthquakes are listed by increasing latitude.

DATE	REG	FRAME	DATE	FRAME	DATE	REG	FRAME	DATE	REG	FRAME
1900/ 2/ 9		B 01	1937/ 3/26	J 05	1946/ 6/18		C 10	1951/ 6/20		K 14
1905/ 1/ 1		C 01	1937/ 5/10	K 05	1946/ 7/19		D 10	1951/ 7/18		L 14
1908/ 1/27		D 01	1937/ 7/25	L 05	1946/ 8/24		E 10	1951/ 8/ 6		M 14
1912/ 1/ 5		E 01	1937/ 8/31	M 05	1946/10/28		F 10	1951/ 9/ 1		N 14
1915/ 8/19		F 01	1937/10/20	N 05	1946/12/25		G 10	1951/10/12		O 14
1917/ 5/31		G 01	1937/12/ 3	O 05	1947/ 2/ 1		H 10	1951/11/15		P 14
1918/ 6/22		H 01	1938/ 1/31	P 05	1947/ 3/ 4		I 10	1951/12/23		B 15
1920/ 7/16		I 01	1938/ 4/14	B 06	1947/ 4/10		J 10	1952/ 2/ 4		C 15
1923/ 7/23		J 01	1938/ 6/ 3	C 06	1947/ 4/11		K 10	1952/ 3/ 3		D 15
1926/11/ 9		K 01	1938/ 7/24	D 06	1947/ 4/27		L 10	1952/ 4/10		E 15
1928/ 9/23		L 01	1938/ 9/23	E 06	1947/ 6/ 7		M 10	1952/ 5/16		F 15
1930/ 4/29		M 01	1938/12/ 3	F 06	1947/ 7/24		N 10	1952/ 7/10		G 15
1931/10/ 9		N 01	1939/ 1/22	G 06	1947/ 7/28		O 10	1952/ 7/21		H 15
1932/ 1/31		O 01	1939/ 3/15	H 06	1947/ 8/19		P 10	1952/ 7/23		I 15
1932/ 3/13		P 01	1939/ 4/26	I 06	1947/ 9/23		B 11	1952/ 7/26		J 15
1932/ 4/27		B 02	1939/ 5/17	J 06	1947/10/31		C 11	1952/ 8/ 1		K 15
1932/ 6/10		C 02	1939/ 6/25	K 06	1947/11/27		D 11	1952/ 8/20		L 15
1932/ 7/22		D 02	1939/ 8/20	L 06	1947/12/31		E 11	1952/ 9/16		M 15
1932/ 8/29		E 02	1939/10/13	M 06	1948/ 2/10		F 11	1952/10/29		N 15
1932/10/ 9		F 02	1939/12/19	N 06	1948/ 3/ 7		G 11	1952/11/24		O 15
1932/12/ 9		G 02	1940/ 2/ 9	O 06	1948/ 4/ 5		H 11	1952/12/13		P 15
1933/ 3/ 7		H 02	1940/ 5/ 4	P 06	1948/ 5/ 9		I 11	1953/ 1/11		B 16
1933/ 3/11		I 02	1940/ 5/22	B 07	1948/ 6/12		J 11	1953/ 1/31		C 16
1933/ 3/11		J 02	1940/ 6/ 8	C 07	1948/ 7/17		K 11	1953/ 2/16		D 16
1933/ 3/13		K 02	1940/ 7/21	D 07	1948/ 8/18		L 11	1953/ 3/ 2		E 16
1933/ 5/ 8		L 02	1940/ 9/22	E 07	1948/10/ 3		M 11	1953/ 3/22		F 16
1933/ 8/ 1		M 02	1940/11/17	F 07	1948/11/14		N 11	1953/ 4/13		G 16
1933/10/ 3		N 02	1941/ 2/11	G 07	1948/12/ 5		O 11	1953/ 5/ 6		H 16
1933/11/23		O 02	1941/ 4/19	H 07	1948/12/13		P 11	1953/ 5/20		I 16
1934/ 1/ 4		P 02	1941/ 7/ 1	I 07	1949/ 1/ 7		B 12	1953/ 6/ 6		J 16
1934/ 1/30		B 03	1941/ 7/25	J 07	1949/ 2/11		C 12	1953/ 6/21		K 16
1934/ 2/16		C 03	1941/ 9/14	K 07	1949/ 3/13		D 12	1953/ 7/ 9		L 16
1934/ 3/20		D 03	1941/10/23	L 07	1949/ 4/22		E 12	1953/ 8/ 2		M 16
1934/ 4/22		E 03	1941/12/ 9	M 07	1949/ 5/ 4		F 12	1953/ 8/28		N 16
1934/ 5/22		F 03	1942/ 1/18	N 07	1949/ 5/17		G 12	1953/ 9/18		O 16
1934/ 6/ 8		G 03	1942/ 2/22	O 07	1949/ 6/ 4		H 12	1953/10/17		P 16
1934/ 7/13		H 03	1942/ 4/11	P 07	1949/ 7/10		I 12	1953/11/13		B 17
1934/ 8/25		I 03	1942/ 5/31	B 08	1949/ 8/ 4		J 12	1953/12/ 9		C 17
1934/ 9/21		J 03	1942/ 8/ 7	C 08	1949/ 8/27		K 12	1953/12/25		D 17
1934/10/16		K 03	1942/10/ 8	D 08	1949/10/ 5		L 12	1954/ 1/13		E 17
1934/11/17		L 03	1942/11/ 2	E 08	1949/11/ 1		M 12	1954/ 1/26		F 17
1934/12/17		M 03	1942/12/14	F 08	1949/11/ 7		N 12	1954/ 2/18		G 17
1935/ 1/ 5		N 03	1943/ 2/12	G 08	1949/12/ 3		O 12	1954/ 3/14		H 17
1935/ 2/ 6		O 03	1943/ 3/29	H 08	1950/ 1/ 1		P 12	1954/ 3/19		I 17
1935/ 2/27		P 03	1943/ 4/21	I 08	1950/ 1/24		B 13	1954/ 3/23		J 17
1935/ 3/21		B 04	1943/ 5/30	J 08	1950/ 2/23		C 13	1954/ 4/ 9		K 17
1935/ 4/25		C 04	1943/ 7/27	K 08	1950/ 3/20		D 13	1954/ 4/27		L 17
1935/ 5/11		D 04	1943/ 9/24	L 08	1950/ 3/23		E 13	1954/ 5/13		M 17
1935/ 5/20		E 04	1943/11/ 4	M 08	1950/ 4/17		F 13	1954/ 6/10		N 17
1935/ 6/19		F 04	1944/ 1/ 4	N 08	1950/ 5/21		G 13	1954/ 7/10		O 17
1935/ 7/21		G 04	1944/ 3/ 9	O 08	1950/ 7/ 7		H 13	1954/ 8/13		P 17
1935/ 9/ 4		H 04	1944/ 6/ 6	P 08	1950/ 7/29		I 13	1954/ 9/22		B 18
1935/ 9/30		I 04	1944/ 6/22	B 09	1950/ 8/22		J 13	1954/11/ 4		C 18
1935/10/25		J 04	1944/ 8/12	C 09	1950/ 9/ 9		K 13	1954/12/19		D 18
1935/11/24		K 04	1944/ 9/24	D 09	1950/10/ 1		L 13	1955/ 1/13		E 18
1935/12/30		L 04	1944/11/16	E 09	1950/10/31		M 13	1955/ 2/11		F 18
1936/ 2/ 1		M 04	1945/ 1/ 1	F 09	1950/11/14		N 13	1955/ 3/ 7		G 18
1936/ 3/ 3		N 04	1945/ 2/25	G 09	1950/11/25		O 13	1955/ 4/ 4		H 18
1936/ 4/20		O 04	1945/ 4/20	H 09	1950/12/12		P 13	1955/ 5/ 9		I 18
1936/ 5/23		P 04	1945/ 6/27	I 09	1950/12/14		B 14	1955/ 6/10		J 18
1936/ 7/ 1		B 05	1945/ 8/19	J 09	1950/12/15		C 14	1955/ 7/ 7		K 18
1936/ 8/10		C 05	1945/10/ 9	K 09	1950/12/15		D 14	1955/ 8/ 8		L 18
1936/ 9/13		D 05	1946/ 1/ 1	L 09	1950/12/17		E 14	1955/ 9/17		M 18
1936/ 9/24		E 05	1946/ 3/ 7	M 09	1950/12/24		F 14	1955/10/24		N 18
1936/10/13		F 05	1946/ 3/18	N 09	1951/ 1/ 2		G 14	1955/11/12		O 18
1936/11/18		G 05	1946/ 3/25	O 09	1951/ 2/ 3		H 14			
1937/ 1/ 3		H 05	1946/ 4/16	P 09	1951/ 3/22		I 14			
1937/ 2/21		I 05	1946/ 5/13	B 10	1951/ 5/18		J 14			

FIGURE 5. Sample Microfiche Index Frame for Chronological File

A sample page for the chronological file and for the region file is shown in Figures 6 and 7. The page format for the two types of files is identical except for the position of the key parameters. A heading appears at the top containing the catalog title, edition, type of file, and generation date of file. Below the title heading are column headings followed by the earthquake records. As a visual aid, a break in the records occurs before the change to a new year in the chronological file and before a new region in the region file. An explanation of the column heading abbreviations is provided in Table 2. Keys to the parameter codes (appendix A) and literature reference numbers (appendix B) are also provided.

All information on the magnetic tape catalog is contained in the microfiche catalog except the comments. The comments are generally location descriptions and are only provided for pre-1932 earthquakes. Thus, for economy of space, the comments have been omitted in the microfiche version.

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CALIFORNIA DIVISION OF MINES AND GEOLOGY
EARTHQUAKE CATALOG SYSTEM

EARTHQUAKE CATALOG OF CALIFORNIA, 1900–1974 EDITION 1
CHRONOLOGIC LISTING

5 NOV 1977 PAGE 1

Y M D H M S	N LAT	W LONG	DEPTH	Q	REF	MAG	T	REF	INT	T	REF	FELT AREA	REF	LIVES LOST	REF	PROPERTY DAMAGE	REF	ID-NO
1900/ 2/ 9 12:30: 0.0	38.2	122.7			7				6	B	4							4400001
1900/ 4/30 22:41:14.0	36.9	121.6			7	4.5	D	7	6	B	4	30,000	7					3200001
1900/ 9/20 7:55: 0.0	37.9	122.3			7				5	B	4							3900001
1900/ 9/28 12:17: 0.0	37.0	121.6			7				5	B	4							3800001
1901/ 3/ 3 7:45: 0.0	36.0	120.5			3	5.5	D	7	8	C	3	104.000	3					3100001
1901/12/11 21:58: 0.0	37.3	121.6			7				5	B	4							3800002
1901/12/14 16:13:58.0	37.9	122.3			7				5	B	4							3900002
1901/12/27 11: 0: 0.0	34.1	117.3			7				6	B	4							1500001
1902/ 4/19 16: 9: 0.0	37.8	122.2			7				6	B	4							3900003
1902/ 5/19 18:31: 0.0	38.3	121.9			7	5.5	D	7	8	C	3	52,000	3					4300001
1902/ 5/21 6:20: 0.0	38.2	122.0			7	4.0	D	7	6	C	7							4400562
1902/ 5/22 7:40: 0.0	33.8	117.9			7				5	C	7							0800974
1902/ 6/11 2:45: 0.0	33.7	117.1			7	4.5	D	7	5	C	7	33,000	7					0800973
1902/ 7/ 8 9:45: 0.0	33.7	117.9			7				5	B	4							0800001
1902/ 7/28 6:57: 0.0	34.6	120.4			7				8	C	3							1800001
1902/ 7/31 9:20: 0.0	34.7	120.3			7	5.5	D	7	8	C	7							1800002
1902/ 8/ 1 3:30: 0.0	34.6	120.4			7				8	C	7							1800003
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1902/ 9/18 11:51: 0.0	37.9	122.4			7				6	B	4							3900005
1902/12/12 0: 0: 0.0	34.8	120.4			7				7	C	3							1800006
1903/ 1/ 8 0:30: 0.0	35.3	119.0			7				6	B	4							2400391
1903/ 6/11 13:12: 0.0	37.6	121.8			7	5.5	D	7	7	C	3	150,000	7					3800003
1903/ 7/24 20:26: 0.0	39.5	122.0			3	4.5	D	7	7	C	3	25,000	7					4800001
1903/ 7/29 7:13: 0.0	35.7	121.3			7				5	B	4							2600001
1903/ 8/ 3 6:49: 0.0	37.3	121.8			7	5.5	D	7	7	C	3	130,000	4					3800004
1903/ 9/16 12:10: 0.0	33.8	117.6			7	4.0	D	7	6	B	4	10,000	7					0800002
1903/12/ 9 16:44: 0.0	40.8	124.2			7				6	B	4							5500001
1903/12/25 17:45: 0.0	34.0	118.0			3				6	C	3							1600001
1904/ 4/16 9:20: 0.0	40.5	122.4			7	4.5	D	7	6	B	4	14,000	7					5300001
1904/ 4/21 11:50: 0.0	37.3	121.9			7	4.0	D	7	5	B	4							3800005
1904/ 5/ 1 18:30: 0.0	34.3	119.3			7				6	B	4							1700001
1904/ 7/30 10:26: 0.0	38.5	122.0		F	7	4.5	D	7	6	B	4	15,000	7					4400002
1904/ 8/27 20:58:47.0	37.3	121.6			7				6	B	4							3800006
1904/12/14 15:10: 0.0	37.9	122.3			7	4.0	D	7	5	B	4							3900006

•• B 01 ••

•• B 01 ••

FIGURE 6. Sample Microfiche Frame for Chronological File

•• N 13 ••

CALIFORNIA DIVISION OF MINES AND GEOLOGY
EARTHQUAKE CATALOG SYSTEM

EARTHQUAKE CATALOG OF CALIFORNIA, 1900–1974 EDITION 1
LISTING BY REGION

5 NOV 1977

PAGE 1569

ID-NO	N LAT	W LONG	DEPTH	Y M D H M S O	REF	MAG	T	REF	INT	T	REF	FELT AREA	REF	LIVES LOST	REF	PROPERTY DAMAGE	REF
3900041	37.70	122.16		1932/ 2/25 7:35: 0.0 B	1				4	C	6						
3900181	37.70	122.18		1947/10/ 8 14:25: 0.0 C	1	2.7	A	1		A	1						
3900183	37.70	122.20		1947/11/ 3 8:15: 0.0 D	1					A	6						
3900520	37.70	122.30		1956/ 7/31 15:59.14 0 C	1	1.7	A	1									
3900182	37.70	122.33		1947/10/31 13:20: 0.0 C	1	2.5	A	1									
3900441	37.70	122.38		1955/ 4/ 4 17:34:32.0 A	1	1.6	A	1									
3900532	37.70	122.42		1956/ 9/24 16:50:26.0 C	1	1.8	A	1									
3900270	37.70	122.47		1950/10/23 7:12: 4.0 B	1	1.3	A	1									
3900465	37.70	122.48		1955/ 6/30 11:11:51.0 C	1	2.8	A	1	5	C	6						
3900560	37.70	122.48		1957/ 3/22 19:56:33.6 C	1	2.7	A	1									
3900020	37.7	122.5		1906/ 6/ 5 7:51: 0.0	7				5	B	12						
3900019	37.7	122.5		1906/ 5/18 4:21: 0.0	7				6	B	12						
3900018	37.7	122.5		1906/ 5/17 8:18: 0.0	7				6	B	12						
3900013	37.7	122.5		1906/ 4/18 19: 0: 0.0	7				5	B	12						
3900012	37.7	122.5		1906/ 4/18 16:19: 0.0	7				5	B	12						
3900011	37.7	122.5		1906/ 4/18 16:15: 0.0	7				5	B	12						
3900010	37.7	122.5		1906/ 4/18 16:14: 0.0	7				5	B	12						
3900014	37.7	122.5		1906/ 4/18 23: 0: 0.0	7				5	B	12						
3901696	37.7	122.5		1906/ 4/18 22:35: 0.0	7				6	B	12						
3901695	37.7	122.5		1906/ 4/18 22:30: 0.0	7				6	B	12						
3900017	37.7	122.5		1906/ 5/15 1:20: 0.0	7				5	B	12						
3900016	37.7	122.5		1906/ 4/25 23:15: 0.0	7				7	B	12						
3900015	37.7	122.5		1906/ 4/25 20: 0: 0.0	7				5	B	12						
3900009	37.7	122.5		1906/ 4/18 13:12:21.0 D	100	8.3	A	11	11	C	3	975,000	12	700	14	$524,000,000	14
3900007	37.7	122.5		1905/ 1/ 1 23:38: 0.0	7	4.0	D	7	6	D	4						
3900632	37.70	122.50		1957/ 3/23 2:48: 8.0 A	1	3.4	A	1	5	C	6						
3900640	37.70	122.50		1957/ 3/23 5:42:13.0 A	1	3.2	A	1	5	C	6						
3900551	37.70	122.50		1957/ 3/22 19:50:16.0	1	3.2	A	1		A	6						
3900552	37.70	122.50		1957/ 3/22 19:51:51.0	1	3.0	A	1									
3900759	37.70	122.50		1957/ 4/14 23: 0: 2.0 D	1	2.9	A	1									
3900752	37.70	122.50		1957/ 4/ 8 0:18:24.0 D	1	2.9	A	1		A	6						
3900701	37.70	122.50		1957/ 3/24 19:11:16.0 D	1	2.8	A	1		A	6						
3900667	37.70	122.50		1957/ 3/23 16:56:32.0 D	1	2.8	A	1		A	6						
3900694	37.70	122.50		1957/ 3/24 6:26:51.0 D	1	2.7	A	1	4	C	6						
3900720	37.70	122.50		1957/ 3/26 14:51:29.0 D	1	2.7	A	1	5	C	6						
3900702	37.70	122.50		1957/ 3/24 19:52:33.0 D	1	2.5	A	1		A	6						
3900699	37.70	122.50		1957/ 3/24 15:34:12.0 D	1	2.4	A	1		A	6						
3900743	37.70	122.50		1957/ 3/31 16:43:26.0 D	1	2.4	A	1		A	6						
3900722	37.70	122.50		1957/ 3/26 15:20:53.0 D	1	2.4	A	1		A	6						
3900727	37.70	122.50		1957/ 3/27 7: 4:49.0 D	1	2.3	A	1									
3900681	37.70	122.50		1957/ 3/23 22:55:16.0 D	1	2.3	A	1		A	6						
3900580	37.70	122.50		1957/ 3/22 20:35:35.0 D	1	2.3	A	1		A	6						
3900561	37.70	122.50		1957/ 3/22 19:57:36.0 D	1	2.2	A	1		A	6						
3900650	37.70	122.50		1957/ 3/23 10:57:18.0 D	1	2.2	A	1		A	6						
3900755	37.70	122.50		1957/ 4/10 11:42:27.0 D	1	2.2	A	1									
3900576	37.70	122.50		1957/ 3/22 20:27: 6.0 D	1	2.1	A	1		A	6						
3900754	37.70	122.50		1957/ 4/10 11: 8:43.0 D	1	2.1	A	1									
3900661	37.70	122.50		1957/ 3/23 13:56:11.0 D	1	2.0	A	1		A	6						

•• N 13 ••

•• N 13 ••

FIGURE 7. Sample Microfiche Frame for Region File

Table 2. Microfiche Record Headings Abbreviations

Heading Abbreviations	Explanation
ID–NO	EVENT IDENTIFICATION NUMBER
Y	YEAR
M	MONTH
D	DAY
H	HOUR
M	MINUTE
S	SECOND
N LAT	LATITUDE IN DEGREES NORTH
W LONG	LONGITUDE IN DEGREES WEST
DEPTH	FOCAL DEPTH IN KILOMETERS
Q	QUALITY OF HYPOCENTER (CODED)
REF	LITERATURE REFERENCE NUMBER
MAG	MAGNITUDE
INT	INTENSITY
T	TYPE (CODE)
FELT AREA	TOTAL FELT AREA IN SQUARE KILOMETERS
LIVES LOST	NUMBER OF HUMAN LIVES LOST
PROPERTY DAMAGE	ESTIMATED PROPERTY LOSS IN U.S. DOLLARS (at time of earthquake)

DATA SOURCES

Earthquake Catalog of California data sources fall under two principal headings: (1) catalogs and other compilations; and (2) accounts of individual events in newspapers, technical literature, and other documents. For events prior to 1932, the primary data sources are the statewide catalogs of Townley and Allen, and of Coffman and von Hake. For events since 1910, in northern California, the primary data source is the catalog of Bolt and Miller. New or refined estimates of felt areas, locations, and magnitudes have been made from newspaper accounts and seismological literature, as described by Toppozada and others in CDMG Special Report 135. Since 1932, the principal data sources are the Seismological Laboratory of the California Institute of Technology for events in southern California, U.C. Berkeley for events in northern California, and the Office of Earthquake Studies of the U.S. Geological Survey for events since 1969 in the central Coast Ranges of California.

Most of the catalog information on intensities, felt areas, lives lost, and property damage is taken from publications of the National Oceanic and Atmospheric Administration: "U.S. Earthquakes," "Earthquake History of the United States," and "Earthquake Investigations in the United States." (Appendix B lists the data sources.)

METHOD OF SYNTHESIS

A hard copy of the pre-instrumental portion (1900–1931) of the earthquake catalog file, including a text describing the method of compilation, is available as CDMG Special Report 135. The method used to compile the instrumental portion (from 1932 onward) of this catalog is described in the present report.

Owing to substantial redundancy among the Caltech, U.C. Berkeley, and USGS catalogs, a scheme was devised to eliminate duplication of records while maintaining completeness in the merging process. Source regions were assigned to each seismograph network based, whenever possible, on published network boundaries within which events are considered reasonably well located (figure 8). The Caltech boundary (Hileman and others, 1973) has been extended east, west, and south. The boundaries for the USGS central California network are unmodified from network bulletins. The U.C. Berkeley network is assigned the remaining area. Temporal coverage is 1932–1975 for the Caltech data, 1969–1973 for USGS, and 1932–1974 for U.C. Berkeley. For a given catalog source, an event has one of three dispositions: (1) within the source region; (2) outside the source region; or (3) not present in the source catalog. When testing for redundancy we consider two sources at a time; thus, there are six case combinations:

(1) present in both source catalogs and within appropriate region in one catalog, but not in appropriate region in other;
(2) present in one source catalog and within appropriate region, absent in other source catalog;
(3) present in both source catalogs and within appropriate regions of each source;
(4) present in both source catalogs and not within appropriate region of either source;
(5) present in one source catalog but not in appropriate region, absent in other source catalog; or
(6) absent in both source catalogs.

The merging process is two-phase. The first phase merely selects events that fall within the respective source boundaries from each catalog source and places these records on File I (the main catalog file), and all remaining

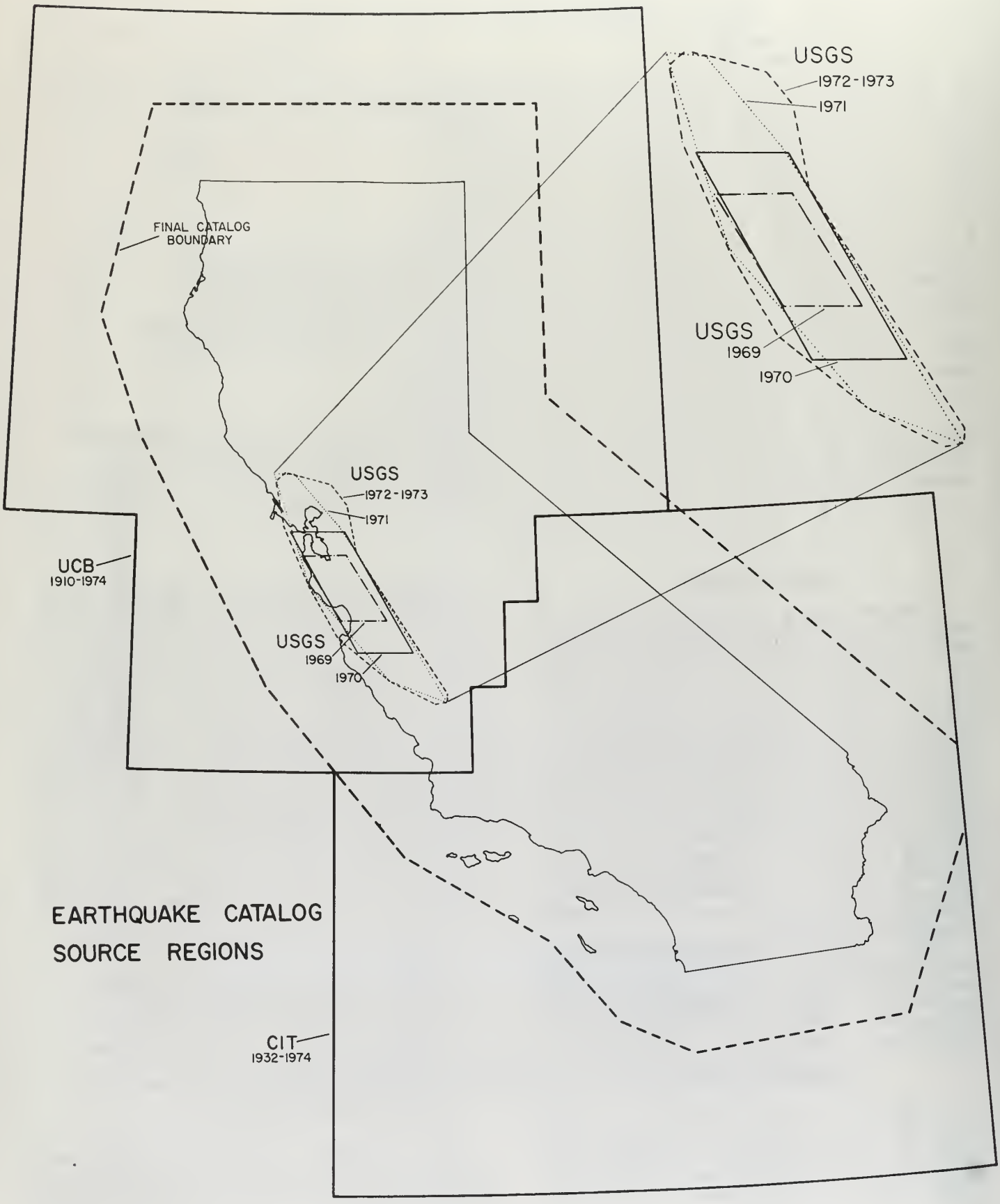

FIGURE 8. Map Showing Earthquake Catalog Source Regions

records on File II (a temporary work file). The former file will contain events kept from case combinations 1, 2, and 3, while the latter file will contain events rejected from case combinations 1, 4, and 5. We can immediately dispose of case 6, since no record of the event will exist. Events kept from cases 1 and 2 are immediately acceptable, but those to be kept from case 3 and those to be discarded from cases 4 and 5 must first be reconciled.

By a system of manual and machine checks, duplicates (case 3) and omissions (cases 4 and 5) are indentified and then added to or deleted from File I, resulting in a uniformly merged and complete file. Files I and II are first scanned independently for records agreeing to 1/4 degree in latitude and longitude, 1/2 magnitude unit, and 30 seconds origin time. Those records from File I are listed as possible duplicates, and those from File II as possible omissions. A decision is then made as to whether a pair of records describes the same event; if so, the record from the source having the nearer seismograph station is retained. Finally, File II is scanned for events unaccounted for in File I (case 5). Even though these events lie outside their corresponding catalog source boundaries, they are added to File I (the main catalog file), thereby providing a full account of all recorded earthquakes. This procedure of manual and machine checks constitutes the second phase of merging. Table 3 summarizes the editing process applied to the Caltech, USGS, and U.C. Berkeley earthquake catalog files.

Following the merging of instrumentally recorded data, earthquakes equal to or greater than intensity V or magnitude 4.0 during the time period 1900–1931 were added to the catalog file. These additional 517 events bring the catalog total to about 42,101 events. Prior to general distribution, the catalog file was trimmed to an approximately 100-kilometer boundary surrounding the state (dashed line in figure 3), and to the time period 1900–1974. This reduced the total number of earthquake entries to 39,578.

CATALOG COMPLETENESS

It cannot be overemphasized that the catalog file is not spatially or temporally complete or homogenous over the entire state during the time period of coverage, except perhaps for events of magnitudes 6 and greater. Only events equal to or greater than magnitude 4.0 or intensity V are accounted for during the time period 1900–1931. Since 1932, the lower magnitude threshold has decreased. Population and seismograph density have increased, decreasing the threshold of detectability over various portions of the state. Table 3 illustrates the effect of seismograph distribution when comparing the total number of earthquakes in each catalog with respect to the temporal and spatial coverage. The USGS catalog covers less than 1/8 of the time and area of either the Caltech or the U.C. Berkeley catalogs, but contains about 3/4 as many records as the Caltech catalog and more records than the U.S. Berkeley catalog. Moreover, because of high instrument density, the origin time and hypocenter locations of the USGS catalog are more accurate.

Because the accuracy of origin time, location, and magnitude depends on the spatial distribution of seismographs, which has improved with great irregularity since 1930, the uncertainty of these parameters will vary widely in the catalog file. This incongruity is compounded by variations in computational methods over the years within and among the principal earthquake-data-generating institutions. As a consequence, these disparities have produced a very inhomogeneous catalog.

As a word of caution to users of the catalog then, epicenter data that are widely separated in space or time, or are from different primary sources, should not be treated with the same level of confidence. Before 1940, origin times for many events were reported only to the nearest minute. During this early period, a value of zero in the seconds field should not be interpreted as being meaningful. In recent years, however, many event origin times are accurate to the nearest tenth of a second, with the epicenter accuracy varying correspondingly.

The reported accuracy of magnitude and focal depth also varies with time. In the early years magnitude was often rounded to the nearest half-unit, but it is now reported to the hundredths place by some networks. Because of higher seismograph station density, focal depths determined by the USGS are generally better than those determined by Caltech, except perhaps in most recent years. Since 1962, U.C. Berkeley routinely reports focal depth as a range in values and on occasions as a single numeric value. A range in focal depth is not included in the CDMG catalog; however, a single reported value is included.

Unfortunately the transition to the more accurate data is, by and large, so gradational with time that it is not possible to identify a definite point of transition from the lower quality to the higher quality instrumental data. Moreover, quality ratings are somewhat arbitrary and are not directly comparable from one source to another (ap-

Table 3. Summary of Instrumental Data Merge

SOURCE	*TIME COVERAGE*	*BEGINNING TOTAL*	*PHASE I*	*PHASE II*	*TOTAL REJECTED*	*TOTAL KEPT POST–31*	*PRE–32*
CIT	1932–1975	20,018	–1,282	+ 86	–1,196	18,822	0
USGS	1969–1973	14,648	–1,563	+1,420	– 143	14,505	0
UCB	1910–1974	10,655	–1,671	+ 177	–1,494	8,257	904
TOTALS		45,321	–4,516	+1,683	–2,833	41,584	904[1]

[1] Only the 517 events equal to or greater than magnitude 4.0 or intensity V have been added to the CDMG catalog file. Many of these events have revised locations and magnitudes as described in CDMG Special Report 135 (Toppazada *et al.*, 1978).

pendix A). For information on station distributions and the limitations and uncertainties of instrumentally recorded data, users of this catalog should consult the catalogs of Hileman and others (1973), Friedman and others (1976), Bolt and Miller (1975), and The Central California Network Bulletins published by the U.S. Geological Survey.

A steady improvement in detection and location of earthquakes statewide, as well as greater uniformity in data presentation, is expected in the future. At the present time, however, much of the Sierra Nevada and most of northern California is still inadequately instrumented. As a result, the completeness and uniformity of the catalog suffers in these regions.

ACKNOWLEDGEMENTS

This catalog file is a product of the Earthquake Catalog System project originally proposed by R. W. Greensfelder and continued under the direction of R. W Sherburne. D. A. Rodgers designed and developed the prototype system with the assistance of M. Hanson. The generation of the earthquake data file would not have been possible without the cooperation of the National Oceanic and Atmospheric Administration, the Office of Earthquake Studies of the U.S. Geological Survey, the Seismological Laboratory of the California Institute of Technology, and the Seismographic Stations of the University of California, Berkeley. Collectively, these organizations have generated most of the data contained in this file. The State of California is indebted to these organizations for the valuable service they render.

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APPENDIX A

Key to Record Parameter Codes

I. Quality of Hypocenter

A. Source: U.C. Berkeley (REF 001)

Epicenter quality is subjective ranging in quality from high to low as follows:

A—Excellent
B—Good
C—Fair
D—Poor

B. Source: Cal Tech (REF 002)

A—Epicenter specially investigated
B—Epicenter probably within 5 km origin time to nearest second
C—Epicenter probably within 15 km origin time to a few seconds
D—Epicenter not known within 15 km rough location
E—Very rough location

C. Source: USGS (REF 009)

	Epicenter	*Focal Depth*
A—Excellent	1 km	2 km
B—Good	2.5	>5
C—Fair	5	>5
D—Poor	>5	>5

II. Type of Magnitude

A—Local Richter
B—Surface wave
C—Body wave
D—Local estimated from intensity
E—Local estimated from duration

III. Type of Intensity

A—No intensity given but felt
B—Rossi-Forel
C—Modified Mercalli

APPENDIX B

Key to Record Literature Reference Numbers

1 University of California, Berkeley (1976). Magnetic tape catalog of earthquakes in northern California, 1910–1974.

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APPENDIX C

Error Notification Form

Please fill out error notification form carefully and include sources of information if correct data are supplied. Your cooperation will insure an improved catalog in subsequent editions. THANK YOU

EVENT I.D. (OR TIME AND DATE IF A NEW EVENT)	PARAMETER THAT IS MISSING OR IN ERROR	CORRECT VALUE OF PARAMETER	DATA SOURCE

Send error notification form to: Charles R. Real
California Division of Mines and Geology
2815 O Street
Sacramento, CA 95816

Microfiche housed in Microform Collection, lst floor, under call number QE89 A1 C32 no.52 mf11

MICROFICHE NO.	TYPE OF LISTING	BEGINNING RECORD
1	Chronological	1900/2/9
2	Chronological	1955/12/10
3	Chronological	1971/6/1
4	Chronological	1974/1/11
5	Magnitude 5 and Greater (Chrono)	1901/3/3
6	Magnitude 6 and Greater (Chrono)	1906/4/18
7	Region	01
8	Region	18
9	Region	32
10	Region	57